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# On the Appropriateness of Incident Management Systems in Developing Countries: A Case from the UAE

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**Abstract**

Road traffic incidents are eliciting growing public concerns due to their devastating social, economical, and environmental impacts. The severity of these random events is particularly alarming in developing countries, where the situation is just worsening. Recently, Incident Management Systems (IMSs) have been proposed as powerful tools to enhance the coordination and management of rescue operations during traffic accidents. However, most of the available commercial IMS solutions are designed for large metropolitan cities and within the contexts of developed nations. This paper explores the issues of appropriateness and customization of IMS solutions in developing countries through an exploratory inquiry consisting of a case study from the United Arab Emirates (UAE). The paper also explores the important issues related to managing the organizational changes that an IMS introduces to the operations of the command and control room. This contribution calls for the development of more comprehensive theoretical frameworks that can guide towards the implementation of appropriate IMS solutions in developing countries. Our research highlights the need for developing countries to acquire appropriate IMS solutions that are tailored to the local organizational work context in which these systems will be used. The experience reported herein can also inspire other public safety agencies in developing countries to consider the option of developing customized IMS solutions that best suit their needs.

**Keywords**: Incident Management System (IMS); technology adoption; technology management; IT innovation and diffusion; E-collaboration; appropriateness; digital divide.

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## Introduction

Traffic incidents have devastating social, economic, and environmental impacts on society. World Health Organization (WHO) statistics indicate that road traffic injuries are a leading cause of death, killing nearly 1.2 million people annually (approximately 90% of these deaths took place in developing countries) and leaving about 10 million people in permanent disability. This number is predicted to rise, making road accidents the eighth leading cause of death by 2030, unless urgent measures are taken. It is also estimated that traffic accidents are costing developing and transitional countries US$100 billion every year (World Bank, 2002); which is roughly double the total annual aid and lending awarded from international institutions to these countries. Unfortunately, while the number of traffic accidents is being brought to lower levels in developed countries, the situation is just worsening in developing countries (Ali, 2010).

Recently, Information and Communication Technologies (ICTs) in the form of Incident Management Systems (IMSs) have been proven to be powerful tools to enhance the coordination and management of rescue operations during traffic accidents. During emergency rescue operations, prompt access to the right information by the right person or agency is crucial for the success of the rescue operation. An IMS is a real-time decision support system that enhances the communication between emergency response teams at the Command and Control Room (CCR) and the emergency patrol units. The IMS also optimizes decisions, facilitates inter-agency communication and enables post-incident data analysis. However, currently the benefits gained from the deployment of IMSs tend to be unevenly distributed, with developing countries still lagging in the acquisition, adaptation, and successful adoption of these systems. There are however great opportunities for developing countries to adopt IMS solutions that best fit their socio-technical, organizational, and economic contexts. Failure to do so might just widen the digital divide.

The transfer of ICT from the developed world to developing countries has been the subject of strong debates for the past years (Avgerou, 2002). Several studies (see for example: Allen, 2000; Macome, 2008; Gould, Gomez and Camacho, 2010 and the references cited therein) have shown that the success of technology adoption is contingent upon the technical and socio-organizational contexts in developing countries and the ability of these countries to effectively adapt ICT to their local needs. Heeks (2002) showcased many real examples of IS failures in developing countries and emphasized how the cost of various types of IS failures are turning ICT into a driver of global inequality.

This research is a first initiative to explore, via a case study, the appropriateness of IMS solutions in developing countries. The practical underpinnings of this research emphasize the concept of IS adaptation and highlights the need for developing countries to consider the option of developing IMS solutions that are tailored to the local organizational work context, within which incident management is embedded.

The remainder of the paper is organized as follows: Section 2 highlights the growing public concerns about the increase in the number traffic accidents in the UAE. Section 3 presents a discussion on the important interrelated concepts of appropriateness, customization, sustainability, and change management in developing countries. A framework conceptualizing an impacting strategy, whereby new IS tools and technologies create opportunities to reshape institutional emergency response practices is also proposed. Section 4 presents an exploratory case study related to the analysis and design of an "appropriate" IMS solution for a local police department in the UAE. Finally, a summary of the main findings of the paper is provided in section 5.

## Traffic Accidents: A Growing Public Concern in the UAE

The casualty and fatality rates due to traffic accidents in the UAE and other Gulf countries have been shown to be much higher than those in other developing and developed countries. For instance, the UAE has six times more deaths from road traffic accidents per year than the USA and Europe. To date, traffic accidents are the second major cause of death after heart diseases in the UAE (Al-Zubaidi and Sabie, 2005). According to recent statistics released by the UAE Ministry of Interior, there were 243,386 accidents on UAE roads during 2006, an increase of 61% compared to 2005. 1,056 traffic-related deaths were registered in 2007, compared to 878 in 2006, an increase of 16.8 per cent. On the average, one person is injured on UAE roads

every two hours, with one fatality registered every fifteen hours. This increase in the number of road traffic accidents is raising serious public concerns in the UAE. To tackle this public safety concern, several measures have been put in place. These include media awareness campaigns to influence drivers' behavior, tougher legislations and penalties to crack down on speeding and violation of red traffic signals, deployment of new rapid transit systems, and more thorough vehicle inspection routines. In addition, several police departments in the UAE have been experimenting with IMS solutions to streamline and optimize emergency response activities at the command and control rooms.

## Appropriateness, Customization, Sustainability and Change Management

Drawing on earlier research related to ICT transfer to developing countries, as well as on our own experience with IMS adoption in the UAE, we examine herein four main important concepts, namely IMS appropriateness, customization, sustainability, and change management. These four dimensions are interrelated and were key drivers for the case study reported herein.

### Appropriateness

Several commercial public safety and incident management software solutions are available today in the market. Nevertheless, previous research (see for example (Leitinger, 2004; NIJ, 2002; Ramaswamy et. al., 2006; Kim et. al., 2007)) highlighted the fact that there is no "*one-size-fits-all*" IMS solution and that none of the available solutions comprehensively addresses all issues- people, process and technology. In fact, it is well known that emergency management is not a discipline that follows sound behaved rules that make it easy to model, while catering to various contingencies and organizational realities. IMS is a rather complex process, involving various critical "command and control" functions, such as incident management, people management, resource management, notification management, document management, report management, security management, and situational awareness management, among many others (Iannella, Robinson and Rinta-Koski, 2007). As a result, the "right" IMS will depend on many factors, including the local context, unique need of the concerned public safety agency, the allocated budget, the traffic volume, the degree of collaboration, ingenuity and intelligence required, and the level of customization.

Our market investigation and literature review revealed that most commercial IMS solutions have been designed and developed for large metropolitan cities and within a developed country context. The complexity, priorities, budgets, and practices related to incident management in developing countries are however different from those of developed countries. As a result it is not reasonable to assume that IMS solutions designed for developed countries will necessarily be appropriate for developing countries. Here we define the "appropriateness" of an IMS solution as an attribute which infers a solution that is tailored to the peculiar "context" of the application. This context spans a wide spectrum of conditions including economic, environmental, national, institutional, socio-technical, cultural, and linguistic factors. Each of these aspects should be taken into account, as within the same country the context of incident management application might vary from one region to another. For instance, given the disparity among the seven UAE emirates, an IMS solution developed for a big and prosperous emirate like Dubai or Abu-Dhabi might not be suitable for a smaller and less-developed emirate like Fujairah or RAK. It should be noted that IS appropriateness has also been used to describe suitable systems designed for developing nations or underdeveloped rural areas of industrialized nations, where the priority is geared towards using the simplest level of technology that can fulfill the intended purpose. The argument against the appropriateness of transferred IMS solutions to developing countries has been endorsed by earlier research contributions; some of which are briefly outlined below.

Anyimadu (2003) argues that innovative IS applications are often designed and developed without taking into account the social and environmental contexts of developing countries. This led several authors (see for example Chijioke, 2006; Macome, 2008) to stress the need for developing countries to acquire *appropriate* information systems that are *tailored* to the *local context* in which these systems will be used. Walsham (2000) went even further to suggest that developed countries have been transferring new IT solutions to the developing countries for the sake of profitability rather than willingness to help these countries solve their own problems.

Chijioke (2006) notes that many information systems "transferred" to developing countries failed to provide sustainable solutions because (1) they tend to coerce changes in institutional practices to accommodate embedded functionality, (2) they do not address the eccentricities of users' practices, (3) they undermines simplicity and ease of use at the detriment of technical intricacy, and (4) they do not factor-in sustainability needs.

The organizational units of public safety agencies in developing countries differ from those in developed countries in their internal knowledge, practices and capabilities. In particular the "absorptive capacity" (Cohen and Levinthal, 1990) of emergency response teams, that is their ability to assimilate and replicate new knowledge gained from commercial IMS solutions, is typically lower in developing countries. This is mainly attributed to the lack of prior-related knowledge, which is reflected in the ICT skills, managerial competence, language and previous relevant experience.

Heeks (2002) applied contingency theory to show that country context gaps reflected by a mismatch between IS design and local user reality play a major role in the failure of many IS projects in developing countries. Accordingly, the concept of IS "adaptation" was highlighted to reflect the capability of IS to be tailored to the application environment. Benson et.al (2010) introduced the concept of adaptive development, as an ongoing contextual system development model for crisis management. The goal was to create a sustainable and adaptable crisis response and management system.

Timbrell, Andrews, and Gable (2001) noted that Enterprise Systems (ES) vendors and consultants spend considerable efforts with their clients to extract idiosyncrasies reference process models and best practices that can be re-used for general applications to future clients. However, while contextual idiosyncrasies in developed countries are often prevalent, making them applicable across countries and cities, this is not the case in developed countries, where the environment, infrastructural conditions, institutional practices, resources, and capabilities are often different from those of developed counties. For instance, the addressing system in the UAE is still complicated and not easy to remember, as it relies on road numbers, instead of road names. This led most people (including police patrols) to rely on landmarks to localize incidents. As a result, end-users at the CCR find the conventional addressing scheme (area name, street name, building number) embedded in all commercial IMS solutions inappropriate to use. It should be noted that very recently, the Roads and Transport Authority launched a new pilot project to develop a new addressing system which is simple and easy to remember by replacing road numbers by road names. Further, some data field labels supplied by some commercial IMS solutions (such as neighborhood, suburb, area, or block) are meaningless within the UAE context, forcing these fields to be left permanently blank. Some fields translated to classical Arabic were also deemed odd, given that classical Arabic is not the language of the common and that spoken Arabic varies from country to country.

Iannella, Robinson and Rinta-Koski (2007) observed that most IMS solutions were designed according to a Northern model that assumed a need for information outputs similar to that in a northern emergency response organization. They argued that customizing the imported IMS designs to local organizational realities could be a costly alternative. The authors have also found that due to the lack of standardized IMS terminology, and information sharing formats, many countries have adopted their own terminology and command structures by developing their own IMS.

Inherent within most contributions related to ICT adoption is the idea of shared problem solving: the close interaction between the ICT provider and the adopter. According to McEvily and Zaheer (1999), such a close relationship is important, as ICT providers are exposed to a wide variety of solutions to organizational challenges that a large number of firms (typically within the same geographical cluster) face. Accordingly, several studies have made recommendations that may facilitate the successful adoption of ICT. First, it is suggested that the adopter of ICT uses liaison personnel, temporary task forces, and permanent teams to coordinate decisions and actions with the ICT provider. Second, it is recommended that there be a high degree of interaction, socialization, ease of communication and collaboration between the provider of ICT and the adopter of the technology (Nonaka, 1994). Third, it is recommended that the provider of ICT directly participates as a source of specific support services such as on-site assistance and selection and installation of new equipment with the adopter of the ICT (McEvily and

Zaheer, 1999). Fourth, it is suggested that the provider and adopter of ICT build and share common trust, vocabulary, and frames of reference (Davenport and Prusak, 1998). Finally, to support local improvisation, it is suggested that the provider of ICT should work closely with the adopter of the technology to unveil organizational realities. This can be facilitated by using proper tools (such as observations, rich pictures, and prototyping), and by opening the communication channels with those who are closest to the context of implementation and use (Heeks, 2002).

**Customization and Adaptation**

A closely related issue to appropriateness is customization. Many IMS solutions, originally developed for large metropolitan cities in developed countries claim to embed enough flexibility to make them tailored to other contexts, including cities in developing countries. This claim is often justified by the fact that the similarities of incident management contexts worldwide outweigh by far the inherent differences. The attempt of some IMS vendors and third-party consulting firms to leverage and customize existing IMS solutions to serve the needs of public safety agencies in developing countries can be challenged when (1) the abovementioned similarity assumption does not hold or (2) when customization compromises the appropriateness of the solution, or (3) when customization leads to high development cost (Chijioke, 2006). In this case, developing a tailored IMS, based on a "*fresh*" user-needs' analysis and catering for the context of the application would most likely be a more enviable alternative. This option can save time and avoid the risk of changing emergency control practices in order to fit the designed system.

**Sustainability**

The sustainability of IMS solutions refers to the ability to identify and manage risks that threaten the long-term viability of IMS projects (Reynolds and Stinson, 1993). Some of these risks are technical and related to the use of the IMS, while others are associated with the success or failure of the IMS to fulfill the expectations, capability and interests of end-users and public safety agencies (Kimaro, 2006; Walsham, 2000). Wade (2002) noticed that the cost to sustain ICTs over time (in terms of training, support, maintenance and upgrades) can outweigh the initial acquisition cost.

The sustainability of an IMS is a complex process that goes beyond developing new capabilities for end-users to collect and interpret incident data, while coordinating rescue operations. The process must also "fit" within the organizational context by recognizing its socio-technical nature, which involves managing not only technology, but also people and processes. For instance, IMS implementation requires a wide range of knowledge, which covers project knowledge (such as project management, business process management, change management, risk management, and training), technical knowledge (such as software integration, maintenance, and database administration), IMS product-specific knowledge, and business knowledge (Chan, 1999).

Our own experience with IMS projects in the UAE revealed that the failure of the IMS solution to sustain on a long-term the interest and expectations of end-users resulted in abandoned and replaced solutions. In particular, these solutions failed to address the actual needs, and work practices at the CCR, making the new information and process flows, enabled by IMS, meaningless in the eyes of end-users. In one particular case, end users questioned the usefulness of the system in enhancing rescue operations and were reluctant to embrace a different approach. For instance, some of these solutions require the user to click on multiple buttons before completing a single transaction, which some users felt superfluous. End-users felt that the system was pushing sophistication at the expense of simplicity and ease of use. This led to unsustainable IMS projects, whereby emergency response teams struggled to sustain the IMS initiative, as they lack the proper skills and/or motivations to manage, maintain and develop the IMS over time. While proper training and assistance from third-party consultants and vendors at the early stages of an IMS project might provide temporal relief to some these challenges, the sustainability of these efforts on the long-run still remains questionable.

**Change Management**

The appropriateness of an IMS, in the context of a developing country, must not infer reluctance to introduce changes in the current institutional practices. In fact, the over-focus on a "user-centric" approach might lead to the development of an IMS that is purely aligned with the current practices, even though these practices might embed severe deficiencies. Further, the introduction of an

appropriate technology does not necessarily mean the deployment of low-level technologies that fit end-users' IT skills and knowledge (Elkington, 1986). This leads us to suggest that to achieve appropriateness, one should also allow for an impacting (in addition to aligning) strategy, whereby information systems bring new dimensions and perspectives which are not covered by existing practices. This is particularly needed in developing countries, given the emergence of new IS solutions whose level of business scope transformation (Venkatraman, 1994) goes beyond localized exploitation or integral integration to include business process redesign and business network redesign. We therefore recommend that the relationship be reciprocal as shown in figure 1.

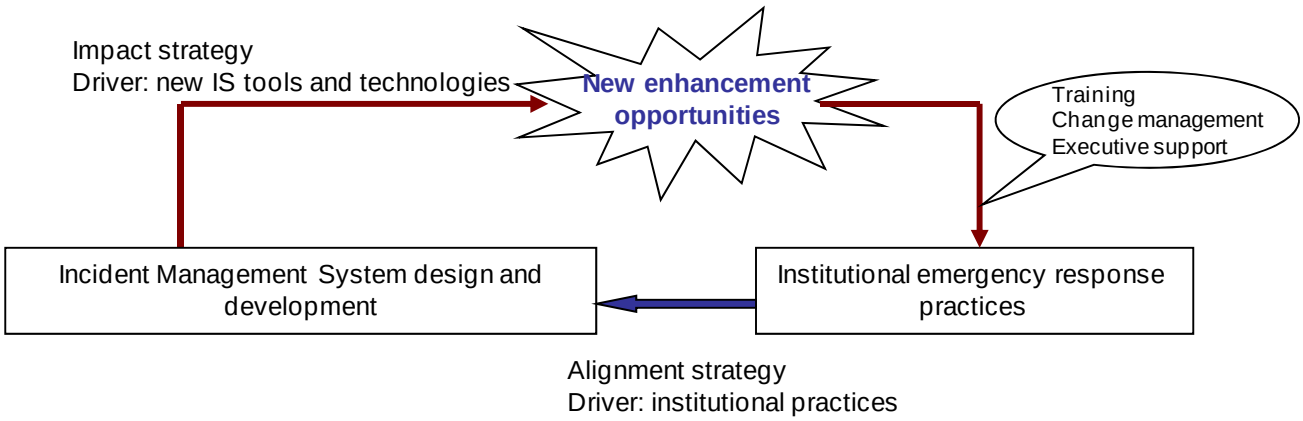


Figure 1. Alignment versus impacting framework

The figure also illustrates that the usage of information systems to induce changes in current emergency-response operations at the CCR often entails additional training and education to end-users, as well as change management and executive support. Using South Africa as an example, Norton (2003) questioned the virtues of customizing information systems to make less IT-skilled users in developing countries comfortable with the technology. Instead she stressed the need to develop training programs to help less-skilled users adapt their mental models to become more comfortable with new interfaces. This requires bridging the gap between existing mental models and the desired level of IT adeptness.

IMS-induced organizational changes must also be assessed to ensure that these are not substantial enough to accentuate the risk of implementation failure. In fact, many IS projects transferred to developing countries failed because of the large gap between "current organizational realities" and "IS design conceptions" (Heeks, 2002). Examples include Thailand's tax computerization Project (Kitiyadisai, 2000), Mexico's general hospital library automation project (Macias-Chapula, 2000), and South Africa health IS project (Braa and Hedberg, 2002).

## Case Study: IMS Appropriateness and development for a Local UAE Police Department

In order to explore the many facets of IMS adoption in developing countries, a case study (exploratory inquiry) related to a local police department, in one of the least prosperous Emirates in the UAE, was conducted.

Currently, when an incident occurs, someone will dial 999 to report the incident to the CCR. The call-taker in the CCR will pick up the call and will manually record the incident's details in a notebook. Sometimes, the call-taker assumes the role of the dispatcher; while in other cases the recorded incident details are manually conveyed to a dedicated dispatcher. In either case, the location of the incident is broadcasted, via analog wireless device, to the emergency patrols. The available patrol that is closest to the incident scene is expected to respond. If no patrol is

available, the dispatcher will call the police station that is closest to the incident scene and will provide the incident's details again. At the police station, the dispatcher will record the incident's details in notebook and then will dispatch a patrol to the incident location. The incident's details are conveyed by phone to the patrol. Once the police patrol clears the incident, it will report to the call-taker or to the police station (whichever is applicable) the completion of its task. In the latter case, the dispatcher (at the police station) will phone the call-taker to notify about the completion of the mission.

The process, described above, suffers from many limitations, including (1) absence of a database, capturing incident response information, (2) labor intensiveness due to excessive paperwork and bookkeeping, (3) lack of visibility to patrols' location and availability, (4) time-consuming process, (5) vulnerability to human-induced errors, (6) lack of optimized decision making, and (7) lack of seamless coordination among the various involved parties. In a subsequent section (*How the IMS Changes the Nature of Incident Management Work?*), we will demonstrate how the proposed computerized approach addresses most of these limitations in order to enhance coordination, decision making, and incident responsiveness.

The proposed computer-based system was designed to implement a real-time data collection function, as well as a collaborative communication platform between the following actors: (1) responders from the incident scene and the call-taker, (2) the call taker and the dispatcher, and (3) the dispatcher and the emergency patrol. Various technology procurement options and design alternatives have been envisaged. At the end, it was deemed more appropriate and viable to develop the IMS in-house, as opposed to buying an off-the-shelf solution or hiring third-party consultants to customize existing commercial IMS products. This decision was justified by the fact that although off-the-shelf systems embed powerful incident management capabilities, they are often generic by nature, and they are not customized to the unique needs of the police department. For example, the address fields in most commercial products are based on Western addressing schemes, which do not apply to the UAE. In addition, most Commercial Off-The-Shelf (COTS) solutions have been designed for large metropolitan cities. As a result, these solutions are often bundled with very powerful and intelligent proprietary modules (Ramaswamy et. al., 2006), which make them excessively expensive to use for a small urban area, like the one considered herein. Further, no previous studies have been conducted to assess the effectiveness of IMS solutions in rural and small urban areas. To our best knowledge, no commercial IMS solutions are available to systematically address the unique needs for small urban areas. It is also well known that, within developed countries, rural areas are very different from one another. This disparity is even amplified when compared to rural areas in developing countries, where road infrastructures, people education and technical skills are still poor. Although few low-end (lightweight) IMS solutions are also available, these were deemed not appropriate, as they are based on centralized and stand-alone client/server architectures, whereby all end users have access to the same centralized system. In our case, each incident management team has its own requirements, and thus needs to have access to customized information that is pertinent to its role.

Discussions with emergency responders at some CCRs in the UAE, revealed that some emergency response agencies have invested substantial amount of money to acquire sophisticated IMS solutions; yet the end-users at the CCR were not satisfied with the system. In most cases, the emergency responders and dispatchers found these solutions complicated, as they were embedding features that they do not need. To this regard, Marcus and Gasperini (2006) illustrated via a case study how the failure of an IMS development project was rooted to the lack of focus on end-users' needs. These findings confirm our earlier discussions in section 3, that developing countries need to acquire appropriate information systems that best address the local context in which these systems will be used.

**User Need Analysis and System Design**

The IMS was developed following a Rapid Application Development (RAD) software methodology. RAD allows for user-driven design, follows an iterative development, relies on the construction of evolutionary prototypes, and uses CASE tools. This approach was selected because it allows for a user-driven and iterative software development. In view of that, we have adopted an evolutionary development process, driven by prototypes and iterative development. The main goal of this study was to work closely with the end-users and major stakeholders

to refine system requirements through successive iterations; until an "appropriate" system is developed. Doll and Deng (2001) have shown that in collaborative applications, such as the one considered here, user participation is key success factor in the design of collaborative systems. Accordingly, various requirement gathering techniques have been explored to better understand the users' needs. These included Joint Application Development (JAD) sessions, direct observations of the operations at the CCR, interview, use cases, document analysis, and prototyping.

The proposed IMS is based on user-centered techniques which were inspired from ISO standard 13407: "Human-centered design process". The standard defines a general framework for including human-centered activities throughout the software development stages. This approach also guides towards appropriateness since it facilitates the implementation of user-centered and iterative development process. By taking into account the context of use, User-centered Design (UCD) activities helped in reducing the risk of unexpected changes in requirements and un-necessary rework. The merits of this user-centric approach, in the context of incident management, has also been showcased by Jäntti (2009). Accordingly, following ISO 13407 standard, the design of the system followed the four classical stages, namely planning the UCD process, specifying the context of use, specifying users and organizational requirements, producing design solutions, and evaluating design against user requirements.

**IMS Main Function: A Brief Overview**

When an incident happens, someone will dial 999 to report the incident to the CCR. At the CCR, the GIS-based call-taker application uses a serial port reading class to capture the caller phone number. The application then sends this number to the RDBMS to retrieve information about the caller. The incident location is determined based on the input received from the incident reporter. The call taker will enter information pertaining to the incident, based on the caller's input. This information includes the location, severity, number of vehicles involved, the type of incident, etc. This information is fed into the Decision Support System (DSS) module of the application. The DSS module provides information related to available resources to the GIS-based dispatcher application. The dispatcher uses the above information to alert the nearest emergency patrol. The information related to the incident is then sent to the nearest emergency patrol using SMS messaging via a mobile unit connected to the GSM network. The GIS-enabled mobile unit application, running on the emergency patrol laptop, automatically displays the GIS location of the incident, as well as other information related to the incident. Once the emergency patrol clears the incident, it will send via the mobile unit application a report to the dispatcher application on its mission. This is again implemented via SMS messaging through a mobile unit. The dispatcher reviews the incidence completion report and decides on the closure of the case.

SMS text-messaging has been selected as the communication method with the emergency patrol since it is a portable, low-cost and highly reliable exchange method; which make it very convenient to use in crisis response missions (Gomez and Turoff, 2007; McAdams, 2006). GIS has also been adopted due to its spatial dimensionality, which makes it very convenient to locate incident and patrol locations (Bapna and Gangopadhyay, 2005). It was also important to customize the GIS application to the local context, by focusing on minimum essential datasets (x-y coordinates) which are necessary for the rescue operation. Tsui (2003) observed that too much geo-information can be confusing to end-users, which eventually can introduce additional delays and erroneous decisions (Dileki and Rashed, 2007). This is particularly true in developing countries, where the commanding officers might lack the proper skills and experience to fully exploit and interpret extensive GIS data (Johansson, Trnka, and Granlund, 2007). In our case, it was also crucial to associate the incident location with the surrounding landmarks, which are displayed on the GIS map. These are the preferred means for emergency patrols to locate incidents, given the cumbersome addressing system currently being used in the UAE.

**How the IMS Changes the Nature of Incident Management Work?**

While the introduction of the IMS to the CCR has the potential to make individual emergency response teams more productive, it does also transform the traditional way incident management has been conducted. As previously highlighted in figure 1, understanding and managing these changes were important activities in this

study. Though in our case, the IMS was not expected to create new types of work, it brings changes in at least four areas, namely (1) the way the work is done, (2) the communication patterns of emergency staff, (3) the decision making and information processing, and (4) the nature of collaboration (Pearlson and Saunders, 2004).

***Changing the way work is done***

The IMS changes the way work is done in many aspects. For instance dispatchers used to rely on direct communication with the officers in the patrol units and have established with them some kind of personal relationship, as they passed emergency rescue missions to them on a daily basis. With the introduction of the IMS, this communication link is eradicated, as the computer is now in charge of routing the rescue mission to the most appropriate patrol vehicle. With the introduction of the IMS, the skills needed for the call-taker, dispatcher and patrol officers also change. They need to be able to use computers, understand basis GIS principles and be able to analyze data. As a result, education and training efforts become mostly needed to enhance employee performance and promote a positive attitude towards system adoption (Marshall, et.al., 2000). Officers in patrol vehicles will soon realize that their whereabouts and movements are being tracked by GPS receivers; something that some will not feel comfortable with. Further, in addition to mastering new tools, emergency response teams are required to improve the way they interact and coordinate among each other, which is crucial in managing emergency response (Padilha et.al., 2010; Hamilton and Toh, 2010).

***Changing communication patterns of emergency staff***

The IMS changes communication patterns of workers at the CCR. Call-takers used to manually record incident information on a piece of paper and pass it to the dispatcher; so there was a kind of personal communication between these two actors. Further, mobile/radio phone calls used to be the de facto mean of communication between dispatchers and emergency officers. With the advent of the IMS, emergency respondents at the CCR have little opportunities to communicate with other colleagues, as most of the interaction is now with computer terminals. Further, SMS messaging is replacing personal voice communication as the official method of communication.

***Changing decision making and information processing***

The IMS does not only alter the decision making process for handling emergency and rescue operations, but also the granularity of the data that is used as input to these decisions. For example, the combination of GPS and GIS technologies enable emergency personnel to benefit from more accurate and timely data related to the locations of the incident and the patrol vehicles that are available for dispatching. These locations are graphically and conveniently displayed on GIS maps, enabling the implementation of spatial decision-making applications. GIS also enhances situation awareness of dispatchers, enabling them, for instance, to automatically know which patrol vehicle is ready to be dispatched. By providing a standard RDBMS, the IMS also changes the amount and type of information available to the emergency response teams. For instance, various queries can be performed and retrieved from the database, enabling the emergency response teams to have an integrated view of current and past incidents. Queries can be refined to identify accident of specific types or occurring during a specific period. Archived data stored in the database can also be used to generate useful statistical reports and forecast trends. For example, the IMS will potentially maintain a data warehouse, which can be mined to identify the most "troublesome" roads in the region. Besides making critical emergency information more readily accessible for decision making, the IMS embeds a useful Decision-Support System (DSS) that can enhance the decision making process. For instance, the DSS will enable dispatchers to automatically check the availability status of all patrol vehicles. The GIS map also enables the dispatcher to visually localize the closest patrol vehicle that can be assigned to a given accident. Retrieving the dispatching histories of patrol vehicles from the database also enable managers to assess the effectiveness of the various rescue teams in responding to traffic accidents.

***Changing collaboration***

The IMS introduces a new type of team collaboration, often referred to as geo-collaboration (McEachren, et.al., 2005). This is a committed effort of a team to devise new understanding or solution for a spatial-based decision making task. In our case, SMS, GPS and GIS technologies enable the various emergency responders to access and exchange geo-information to improve information sharing.

In particular, our geo-collaborative design philosophy supports asynchronous geo-collaboration (Krek and Bortenschlager, 2006), whereby emergency responders share and exchange meaningful geo-information at different times. In addition, the IMS is creating a new type of "action team" that is virtual by nature. Unlike face-to-face and direct phone/radio conversation mechanisms, all communications between the dispatcher and the mobile units are done through SMS messaging. This renders trust-building among the various emergency responders a more challenging task. This issue of trust in collaborative emergency response coordination is not new (see for example Eryilmaz, Cochran and Kasemvilas, 2009). On the other hand, end-users benefit from the key features of the IMS, including reduced human-induced errors, and better decision making.

## Conclusion and Future Research

Large-scale information systems are often complex, and designed to fulfill the needs of the stakeholders within the context in which they are used. Most of these systems are originating in developed countries and then tailored to the context of developing countries. However, this customization can be a very intrigue endeavor if appropriateness is to be achieved. This paper attempted to explore this important issue through a case study conducted in the UAE. Our work has several implications:

First, it suggests that organizations in developing countries should exercise due diligence before adopting a commercial IMS solution. Part of this carefulness should also focus on exploring the viability of developing the solution in-house, while catering to the local context in which the system will be used.

Second, the experience reported herein confirms earlier studies that highlighted the need for developing countries to acquire appropriate IMS solutions that are tailored to the local contexts in which these applications will be used.

Third, from an IS-research perspective, this study highlights the need for comprehensive theoretical frameworks that can guide towards the development or acquisition of appropriate IMS solutions that best serve the needs of developing countries.

Finally, this study can also inspire other public safety agencies in developing countries to develop IMS solutions that are customized and best suited to their unique needs and resources. We do not however preclude the fact that other IMS adoption strategies, including customization of existing commercial solutions might be viable alternatives for other public safety agencies in developing countries. It would be interesting to see more exploratory inquiries related to IMS adoption and diffusion in other developing countries and see how these compare to the experience reported in this paper.

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